CLAIMS:

1. A method comprising:
storing a packet to one of a plurality of hold queues;
monitoring a loading condition of a transmit queue;
generating a time epoch based on the loading condition; and
transferring the packet from the one of the plurality of hold queues to a transmit queue for delivery to a network device via a downstream channel in response to the time epoch.

2. The method of claim 1, wherein monitoring a loading condition comprises monitoring the amount of data residing within the transmit queue.

3. The method of claim 2, wherein generating a time epoch comprises:
computing a transmission time to deliver the amount of data in the transmit queue;
computing a system load in units of time based on the transmission time; and
computing the time epoch based on the system load and a previous time epoch.

4. The method of claim 3, wherein computing the system load comprises:
comparing the transmission time to a constant lower limit; and
selectively setting the system load based on the comparison.

5. The method of claim 4, wherein selectively setting the system load comprises setting the system load equal to the transmission time when the transmission time exceeds the constant lower limit.

6. The method of claim 4, wherein selectively setting the system load comprises setting the system load equal to the constant lower limit when the constant lower limit exceeds the transmission time.

7. The method of claim 3, wherein computing the time epoch comprises adding the system load to the previous time epoch.

8. The method of claim 1, further comprising:

associating the packet with a service flow;

identifying a service credit associated with the service flow, wherein the service credit represents a bandwidth allocation available for consumption by the service flow; and

assigning the packet to one of the plurality of hold queues based on the identified service credit.

9. The method of claim 8, wherein assigning the packet comprises assigning an initial packet associated with the service flow to the transmit queue.

10. The method of claim 8, wherein assigning the packet comprises:

identifying a target queue state associated with the service flow, wherein the target queue state specifies a current priority level associated with the service flow; and

selecting the one of the plurality of hold queues based on the target queue state.

11. The method of claim 8, wherein assigning the packet comprises:

comparing the service credit to the size of the packet; and

selectively assigning the packet to the one of the plurality of hold queues based on the comparison.

12. The method of claim 11, wherein selectively assigning the packet comprises assigning the packet to the one of the plurality of hold queues when the service credit is greater than or equal to the size of the packet.

13. The method of claim 11, further comprising adjusting the service credit by subtracting the size of the packet from the service credit.

14. The method of claim 11, wherein selectively assigning the packet comprises:

comparing the service credit to the size of the packet; and

selecting a different one of the plurality of hold queues when the service credit is less than the size of the packet.

15. The method of claim 14, wherein selecting a different one of the plurality of hold queues comprises:

adjusting the service credit; and

selecting the different one of the hold queues based on the adjusted service credit.

16. The method of claim 15, wherein adjusting the service credit comprises:

defining a set of configurable service classes;

pre-computing service quanta for each service class in the set, wherein the service quantum represents a pre-computed bandwidth adjustment for different network loading conditions;

associating the packet with one of the service classes;

selecting one of the pre-computed service quanta based on the one of the service classes associated with the packet and a current network loading condition; and

adjusting the service credit based on the selected one of the pre-computed service quanta.

17. The method of claim 14, further comprising:

identifying a target queue state associated with the service flow, wherein the target queue state specifies a current priority level associated with the service flow;

adjusting the target queue state associated with the service flow to demote the target queue state by one or more priority levels; and

selecting the different one of the plurality of hold queues based on the adjusted target queue state.

18. The method of claim 17, wherein adjusting the target queue state comprises:

identifying a service class associated with the packet;

monitoring a loading condition of a transmit queue;

adjusting the service credit based on the determined service class and the monitored loading condition; and

selecting the different one of the plurality of hold queues based on the adjusted service credit and the adjusted target queue state.

19. The method of claim 18, wherein monitoring a loading condition comprises monitoring the amount of data residing within the transmit queue.

20. The method of claim 17, further comprising:

comparing the adjusted target queue state to a lowest priority level; and

dropping the packet when the adjusted target queue state is less than the lowest priority level.

21. The method of claim 1, further comprising transmitting the packet from the transmit queue to the network device via the downstream channel.

22. The method of claim 21, wherein transmitting the packet comprises assigning a queue state to each one of the plurality of hold queues, wherein the queue state represents a priority level for the respective hold queue.

23. The method of claim 22, further comprising reassigning the queue state assigned to each one of the plurality of hold queues in response to the time epoch.

24. The method of claim 23, wherein reassigning the queue state comprises:

demoting the queue state of the highest priority one of the plurality of hold queues to the queue state of the lowest priority one of the plurality of hold queues; and

promoting the queue states of the remaining hold queues by a priority level.

25. A computer-readable medium comprising instructions for causing a programmable processor to:

store a packet to one of a plurality of hold queues;

monitor a loading condition of a transmit queue;

generate a time epoch based on the loading condition; and

transfer the packet from the one of the plurality of hold queues to a transmit queue for delivery to a network device via a downstream channel in response to the time epoch.

26. The computer-readable medium of claim 25, further comprising instruction to cause the processor to:

monitor the amount of data residing within the transmit queue;

compute a transmission time to deliver the amount of data in the transmit queue;

compute a system load in units of time based on the transmission time; and

compute the time epoch based on the system load and a previous time epoch.

27. The computer-readable medium of claim 26, further comprising instruction to cause a processor to:

compare the transmission time to a constant lower limit; and

selectively set the system load based on the comparison.

28. The computer-readable medium of claim 25, further comprising instruction to cause the processor to:

associate the packet with a service flow;

identify a service credit associated with the service flow, wherein the service credit represents a bandwidth allocation available for consumption by the service flow; and

assign the packet to one of the plurality of hold queues based on the identified service credit.

29. The computer-readable medium of claim 28, further comprising instructions to cause the processor to transmit the packet via the downstream channel to the network device.

30. A device comprising a control unit that stores packets from a variable number of service flows to one of a static number of hold queues, monitors a loading condition of a transmit queue, generates a time epoch based on the loading condition, and transfers the packet from the one of the static number of hold queues to the transmit queue for delivery to a network device via a downstream channel in response to the time epoch.

31. The device of claim 30, wherein the control unit monitors a loading condition by monitoring the amount of data residing within the transmit queue.

32. The device of claim 31, wherein the control unit generates a time epoch by computing a transmission time to deliver the amount of data in the transmit queue, computing a system load in units of time based on the transmission time, and computing the time epoch based on the system load and a previous time epoch.

33. The device of claim 32, wherein the control unit computes the system load by comparing the transmission time to a constant lower limit, and selectively setting the system load based on the comparison.

34. The device of claim 33, wherein the control unit selectively sets the system load by setting the system load equal to the transmission time when the transmission time exceeds the constant lower limit.

35. The device of claim 33, wherein the control unit selectively sets the system load by setting the system load equal to the constant lower limit when the constant lower limit exceeds the transmission time.

36. The device of claim 32, wherein the control unit computes the time epoch by adding the system load to the previous time epoch.

37. The device of claim 31, wherein the control unit further identifies service credits associated with the variable number of service flows, wherein the service credits represent a bandwidth allocation available for consumption by the variable number of service flows, and assigns the packets to the static number of hold queues based on the identified service credits.

38. The device of claim 37, wherein the control unit further assigns initial packets associated with the variable number of service flows to the transmit queue.

39. The device of claim 37, wherein the control unit assigns one of the packets by identifying a target queue state associated with one of the service flows, wherein the target queue state specifies a current priority level associated with the one of the service flows, and selecting one of the static number of hold queues based on the target queue state.

40. The device of claim 39, wherein the control unit assigns one of the packets by comparing one of the service credits to the size of the one of the packets, and selectively assigning the one of the packets to the one of the static number of hold queues based on the comparisons.

41. The device of claim 40, wherein the control unit selectively assigns one of the packets by assigning the one of the packets to the one of the static number of hold queues when the one of the service credits is greater than or equal to the size of the one of the packets.

42. The device of claim 40, wherein the control unit adjusts the one of the service credits by subtracting the size of the one of the packets from the one of the service credits.

43. The device of claim 40, wherein the control unit selectively assigns the one of the packets by comparing the one of the service credits to the size of the one of the packets, and selecting a different one of the static number of hold queues when the one of the service credits are less than the size of the one of the packets.

44. The device of claim 43, wherein the control unit selects a different one of the static number of hold queues by adjusting the one of the service credits, and selecting the different one of the hold queues based on the adjusted one of the service credits.

45. The device of claim 44, wherein the control unit adjusts the one of the service credits by:

defining a set of configurable service classes,

pre-computing service quanta for each service class in the set, wherein the service quantum represents a pre-computed bandwidth adjustment for different network loading conditions,

associating the one of the packets with one of the service classes, selecting one of the pre-computed service quanta based on the one of the service classes associated with the one of the packets and a current network loading condition, and

adjusting the one of the service credits based on the selected one of the pre-computed service quanta.

46. The device of claim 44,

wherein the control unit identifies target queue states associated with the service flows, wherein the target queue states specify current priority levels associated with the service flows, and

wherein the control unit adjusts the target queue states associated with the service flows to demote the target queue states one or more priority levels, and selects the different one or more of the static number of hold queues based on the adjusted target queue states.

47. The device of claim 46, wherein the control unit adjusts the target queue states by identifying service classes associated with the packets, monitoring a loading condition of a transmit queue, adjusting the service credits based on the determined service class and the monitored loading condition, and selecting the different one or more of the plurality of hold queues based on the adjusted service credits and the adjusted target queue states.

48. The device of claim 47, wherein the control unit monitors the loading condition by monitoring the amount of data residing within the transmit queue.

49. The device of claim 46, wherein the control unit compares the adjusted target queue states to a lowest priority level, and drops the packet when the adjusted target queue states are less than the lowest priority level.

50. The device of claim 30, wherein the control unit transmits the packets via the downstream channel to the network device.

51. The device of claim 30, wherein the control unit processes the packets by assigning a queue state to each one of the static number of hold queues, wherein the queue state represents a priority level for the respective hold queue.

52. The device of claim 51, wherein the control unit reassigns the queue state assigned to each one of the static number of hold queues in response to the time epoch.

53. The device of claim 52, wherein the control unit reassigns the queue state by demoting the queue state of the highest priority one of the static number of hold queues to the queue state of the lowest priority one of the static number of hold queues, and promoting the queue states of the remaining hold queues by a priority level.

54. A system comprising:

a cable modem; and

a cable modem termination system comprising:

a downstream scheduler that includes a transmit queue,

a load monitor that monitors a loading condition of the transmit queue and generates a time epoch based on the loading condition, and

a queue assignment module that stores a packet to one of a plurality of hold queues, and transfers the packet from the one of the plurality of hold queues to the transmit queue for delivery to the cable modem via a downstream channel in response to the time epoch.

55. The system of claim 54, wherein the load monitor monitors a loading condition by monitoring the amount of data residing within the transmit queue.

56. The system of claim 55, wherein the load monitor generates a time epoch by:

computing a transmission time to deliver the amount of data in the transmit queue;

computing a system load in units of time based on the transmission time; and

computing the time epoch based on the system load and a previous time epoch.

57. The system of claim 56, wherein the load monitor computes the system load by:

comparing the transmission time to a constant lower limit; and

selectively setting the system load based on the comparison.

58. The system of claim 57, wherein the load monitor selectively sets the system load by setting the system load equal to the transmission time when the transmission time exceeds the constant lower limit.

59. The system of claim 57, wherein the load monitor selectively sets the system load by setting the system load equal to the constant lower limit when the constant lower limit exceeds the transmission time.

60. The system of claim 56, wherein the load monitor computes the time epoch by adding the system load to the previous time epoch.

61. The system of claim 54, wherein the queue assignment module associates the packet with a service flow, identifies a service credit associated with the service flow, wherein the service credit represents a bandwidth allocation available for consumption by the service flow, and assigns the packet to one of a plurality of hold queues based on the identified service credit.

62. The system of claim 61, wherein the queue assignment module assigns an initial packet associated with the service flow to the transmit queue.

63. The system of claim 61, wherein the queue assignment module further identifies a target queue state associated with the service flow, wherein the target queue state specifies a current priority level associated with the service flow, and selects one of the plurality of hold queues based on the target queue state.

64. The system of claim 63, wherein the queue assignment module adjusts the target queue state by identifying a service class associated with the packet, adjusting the service credit based on the determined service class and the loading condition monitored by the load monitor, and selecting the different one of the plurality of hold queues based on the adjusted service credit and the adjusted target queue state.

65. The system of claim 64, wherein the queue assignment module further compares the adjusted target queue state to a lowest priority level, and drops the packet when the adjusted target queue state is less than the lowest priority level.

66. The system of claim 61, wherein the queue assignment module further compares the service credit to the size of the packet, and selectively assigns the packet to one of the plurality of hold queues based on the comparison.

67. The system of claim 66, wherein the queue assignment module assigns the packet to one of the plurality of hold queues when the service credit is greater than or equal to the size of the packet.

68. The system of claim 67, wherein the queue assignment module adjusts the service credit upon assigning the packet by subtracting the size of the packet from the service credit.

69. The system of claim 68, wherein the queue assignment module compares the service credit to the size of the packet and selects a different one of the plurality of hold queues when the service credit is less than the size of the packet.

70. The system of claim 68, wherein the queue assignment module adjusts the service credit and selects a different one of the plurality of hold queues based on the adjusted service credit.

71. The system of claim 70, wherein the queue assignment module adjusts the service credit by:

defining a set of configurable service classes,

pre-computing service quanta for each service class in the set, wherein the service quantum represents a pre-computed bandwidth adjustment for different network loading conditions,

associating the packet with one of the service classes,

selecting one of the pre-computed service quanta based on the one of the service classes associated with the packet and a current network loading condition, and

adjusting the service credit based on the selected one of the pre-computed service quanta.

72. The system of claim 54, wherein the downstream scheduler further includes a queue transition module that assigns a queue state to each one of the plurality of hold queues, wherein the queue state represents a priority level for the respective hold queue.

73. The system of claim 72, wherein the queue transition module further reassigns the queue state assigned to each one of the plurality of hold queues in response to the time epoch generated by the load monitor.

74. The system of claim 73, wherein the queue transition module reassigns the queue state by demoting the queue state of the highest priority one of the plurality of hold queues to the queue state of the lowest priority one of the plurality of hold queues, and promoting the queue states of the remaining hold queues by a priority level.

75. The system of claim 54, wherein the downstream scheduler transmits the packet via a downstream channel to the cable modem.